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RECORD OF ORAL HEARING

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ERIC J. STRANG

Appeal 2009-007902
Application 10/673,507
Technology Center 2100

Oral Hearing Held: February 4, 2010

Before JAMES D. THOMAS, LANCE LEONARD BARRY, and STEPHEN C. SIU, *Administrative Patent Judges.*

APPEARANCES:

ON BEHALF OF THE APPELLANT:

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The above-entitled matter came on for hearing on Thursday, February 4, 2010, commencing at 9:33 a.m., at the U.S. Patent and Trademark Office, 600 Dulany Street, Alexandria, Virginia, before Paula Lowery, Notary Public.

THE CLERK: Good morning. Calendar Number 24, Mr. Rudder.

MR. RUDDER: May it please the Board, today I plan to talk about the points we emphasized in the Reply Brief. In particular, I'd like to point to what I consider to be disagreements between the Examiner and Appellant in terms of their reading of Sonderman.

I'd also like to point out that while we believe the features relied on in Tan, et al. and in Jain are really not appropriately applied to the claims of the present application.

Then I'd like to spend some time, if time permits, to basically talk about some secondary considerations that were pointed out in the Reply Brief.

If you'll look briefly at Claim 1, Claim 1 has a number of features I'd like to highlight for just a moment. The first element of Claim 1 talks about inputting process data related to the actual process being performed.

The second element talks about inputting of first principles, physical modeling, including a set of computer encoded differential equations.

I'd like to stop for a moment right there and then, with reference to Sonderman, talk for a minute about the difficulty of, basically, solving the first principles modeled.

Basically, the first principles modeled, as you can tell from the spec, is related to solving equations such as Maxwell equations, the Navier-Stokes theorem tied to equations, and these are typically differential equations that take a great deal of computing power. Indeed, the only reference that really

seems to come close to addressing a capability of doing that is the Jain, et al. reference.

If we look specifically at Sonderman, the Appellants contend that, basically, Sonderman is a simulation-type process; but the simulation process seems to be run in a feedback, or perhaps at most a feed forward-type mechanism.

In Figure 1 of Sonderman, you can see, as pointed out in the Reply Brief on pages 5 and 6, that a metrology tool is used there to provide metrology data which feeds back into the upper left-hand side into a simulation environment.

That simulation environment in Column 8 of Sonderman and Column 5 of Sonderman, for example, produces device physics models or manufacturing recipes. Those recipes are then used to control the processing that goes in processing tool A.

One major point of disagreement in reading the reference involves Column 9, lines 46-51 of Sonderman, and the Reply Brief quoted that, and I'll just read it briefly to you.

It says: "The system then optimizes simulation described above to find more optimal process targets for each silicon wafer SFI to be processed. These target values are then used to generate new control inputs on Line 805 to control a substantive process with silicon wafer SFI."

We believe the language here and the whole of Sonderman indicates that these subsequent processes are for subsequent wafers, else this would not be consistent with the feedback process as described.

It also would not be consistent with the diagram of Figure 4, which shows in a nutshell that Sonderman finds a process to be modeled. He basically runs the model to obtain a simulation result. He's not running a first principle

simulation itself.
He then interfaces the simulation results or processor, and then the processor runs a control under the preexisting simulation result, or what Sonderman referred to as a manufacturing recipe.
The Examiner in his particular rebuttal has read additional terms into Sonderman where he believes that, basically, this means that a subsequent process of a silicon wafer SFI refers to a process occurring on the same wafer at a subsequent time.
Turning now to Tan, et al, Tan, et al. was asserted for teaching of first principal simulation results being produced in a time frame shorter than the actual time frame being performed. It was also cited for a model-based real time process using in situ inputs, but that limitation is in some of the dependent claims.
So we pointed out in the Reply Brief on page 17 that here, once again, like Sonderman Tan is very explicit in saying that his APC, his process control system, receives feed forward and feedback data.
To the Appellant that means that he's not controlling the process that's ongoing with the data being received from the process that is ongoing.
Rather he, like Sonderman, is making some measurement of what has happened; and using feedback control to control a subsequent wafer, or in this case when Tan is talking about feed forward control, he's measuring some property before the wafer, and it's a processing tool. Based on that property, such as the thickness of photo resist, he's then setting the recipe to accommodate those measurements ahead of time.
JUDGE SIU: Could you comment on Tan Column 2 where he says an

advanced process control framework provides model-based real time processing parameters during the process run. It's Column 2, about line 10 or so.

MR. RUDDER: Yes, the first thing I remember about that particular comment is he actually points out in the earlier column that these are unresolved issues. As I recall, that's the word he used. Then, supposedly, his invention would address all these.

I didn't actually see in Tan, in the body of the invention, where he actually described a real time control. He mostly described run-to-run control from wafer to wafer. But regardless, the important point there is if it's model based, it means that in Appellant's view a model has been developed, probably from some first-principle simulation.

For example, you all are probably aware of Ohm's Law, which describes how current flows down a wire. You can basically say the voltage is equal to the current times the resistance. That's a model of what happens in a well-defined geometry when Maxwell's equations are applied.

You can take that model and use it quite frequently and often because it's a reduction from what you might consider is a derivation from Maxwell's equations.

So even here if we accept that Tan did do real time processing, he taught that in the body of his specification of his invention, it still seems he's once again using models to control, much like Sonderman talked about using a device physics model to control.

So the issue here from a technical challenge point of view -- the reason the Appellant believes other people have not done this is it's time intensive. Most time the calculations require so much time that you, essentially, have

to go to a statistical situation or a recipe situation where your process controller can use that statistical information or the recipe information to manage the process control.

JUDGE SIU: Sonderman has the simulation environment that makes process data that goes to the manufacturing environment. The manufacturing environment is the actual process, I'm assuming, in your claim.

So the parameters are made in conjunction with a simulation environment, isn't that right? Then it goes into the manufacturing environment to actually apply those parameters.

Tan discloses process-controlled parameters and those process-controlled parameters are similar to those process parameters that are going into the manufacturing environment in Sonderman. So if we look at it that way, I'm having a hard time seeing a difference between the claimed feature of performing a simulation during an actual process and generating process-control parameters in Tan, which is a simulation similar to that in Sonderman, to control the manufacturing process, such as disclosed in Sonderman, during the process run, as disclosed in Tan. Could you point out what you believe to be the difference between generating the process-control parameters in Tan, which sounds like a simulation as disclosed in Sonderman, during the actual process and the claimed feature of performing a simulation during the performance of the actual process?

MR. RUDDER: I'll try to answer your question. I think I understand it.

I think in reality my belief of what happens is in Sonderman and in Tan you, basically, have a model.

In Sonderman the model comes from a simulation result. It doesn't say it's a first principle simulation, but nevertheless it comes from simulation results. So they simulate the process, and they make a theoretical silicon wafer. Then they derive a manufacturing control recipe. That recipe is like a model.

So when the process control tries to change the pressure in a given process, it looks to see what the manufacturing recipe says it should do. Almost like a look-up table. So it's taken all the up front calculations and all the knowledge derived from the fundamental physics, and it's distilled it down into a model.

Now, the model is what's being used real time to control the process. It doesn't need to go back and do a first run simulation. It doesn't need to go back to the fundamental Maxwell equations. It's going to use the simplified model, B=IR to control what goes on.

Because it's such a simple algorithm, it can calculate that, or it can use look-up tables, and it can quickly find how to control the process real time; but it's not going back and redoing the simulation every time when it needs to make a decision about what to do with a wafer inside the processing --

JUDGE THOMAS: Counsel, what does any of this have to do with the subject matter of Claim 1 to distinguish over what's there?

MR. RUDDER: The subject matter in Claim 1, Step 3 says that you perform the first principle simulation for the actual process being performed during the performance of the actual process.

So here I think the distinction is the art now used does perhaps some type of simulation. We just don't think it's first principles. But it does it off line or beforehand.

JUDGE THOMAS: What does the claim recite as to what the first principle is?

MR. RUDDER: It says in Step 2 that the first principle physical model describes at least one of the basic physical or chemical attributes of a semi-conductor processing tool, and it also describes in Step 2 that it includes this computer-encoded differential equations.

JUDGE THOMAS: Those are the only things that you have recited in the claim to define that language, right?

MR. RUDDER: Yes, it is. Plus the fact that first principles is itself a well-known term in the art. In fact, if you look at Jain for evidence of, basically, trying to use a first principle type of calculation.

JUDGE THOMAS: Okay. Go ahead.

MR. RUDDER: In fact, let's then move forward if we can to look at Jain for just a minute. Jain talks about -- the Examiner applies it for the teaching of a computer-encoded differential equation.

Here they have what they have as a mathematical physical engine. The part that we pointed out to the Examiner is that all this scientific paper seems to do is propose or make conjecture about the type of computer that would be needed, or the type of computer processing that would be needed to basically achieve such a brute force calculation.

You can see there that they, for example, highlight in the Reply Brief on pages 10 and 11 -- they envision using courtyards of processors. They talk about using thousands of processors.

They talk about the construction of a hypothetical, futuristic type of wafer-stacking scheme that can interconnect these wafers to where perhaps they can have the super computing skills they need.

We do not believe that a person in a semi-conductor manufacturing art -- once again the preamble of Claim 1 says the processes are formed by a semi-conductor processing tool -- that that person is going to, basically, even consider applying a hypothetical, unproven, untested system such as Jain into this particular affair.

So we think that Jain essentially backs up the Applicant's position which he stated in the specification that was discussed in the Reply Brief on pages 11 and 12. There the inventors basically pointed out that people recognize the difficulties and the large number of simulations that have been done, and historically these simulations were confined to process-development tools or design tools when time was not an issue.

You could take three days for a calculation to run to solve a tool geometry that you thought was an optimum, but people have struggled -- there was failures of inertia they talk about, and people of ordinary skill in the art, the bottom line -- they typically felt there was inefficient use, and basically the extensive computation resources have been a major impediment to implementing the invention.

This seems to be also backed up by a couple of references that we brought to the Examiner's attention. I think his position is that he can apply at least Key, so it's not particularly relevant, but we bring it as a secondary consideration.

Here Key, which we talked about in our Reply Brief, pages 13 and 14, they are faced with a similar dilemma --

JUDGE THOMAS: Counselor, did you bring this secondary consideration argument and evidence before the Examiner in the Brief?

MR. RUDDER: I think we actually introduced this back during prosecution.

JUDGE THOMAS: Did you make use of it in the Principal Brief?
MR. RUDDER: In the Principal Brief? Yes, I'm fairly sure we did. Do you want the citation to the page?
JUDGE THOMAS: Please.
MR. RUDDER: Yes, page 22 and it probably continues forward to 23, it looks like. Certainly at page 22, and it says: "As specifically part of our Key, et al. reference is evidence of the technological difficulties involved in producing a first principle model simulation," et cetera, et cetera.
So that argument was advanced in the Appeal Brief.
So, finally, I think we're going to point out that Chen also seems very irrelevant because, basically, they also were doing a simulation-type of calculation. Here they also point out, and this is the Reply Brief on pages 14 through 15 that the tools for simulation had generally been developed for research and development purposes and do not adequately address various difficulties that arise in the manufacturing environment.
Chen takes a slightly different approach. He uses a statistical simulation type of affair where, basically, he analyzes things such as variations, mean deviations, and from a long-type of process, empirical-based process, he comes forward with a process-control situation.
JUDGE THOMAS: Counsel, you've just about expired your time.
MR. RUDDER: I'm on my last page. Are there any further questions?
JUDGE THOMAS: I don't believe so.
MR. RUDDER: Thank you very much.

Whereupon, at 9:52 a.m. the proceedings were concluded.